IN THE SPECIFICATION:

Page 1, line 1, to the end of the first paragraph, replace with the following:

BLOWER AND METHOD FOR MOLDING HOUSING THEREOF

Sub B1 This is a Rule 1.53(b) Division of application Serial No. 09/627,004, filed July 27, 2000, now allowed; which in turn is a Rule 1.53(d) Division application of Serial No. 09/090,944, filed June 5, 1998, now U.S. Patent 6,132,771.

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Field of the Invention

The present invention relates to a blower.

Background of the Invention

Reducing equipment in size using electronic devices has prompted the use of high-density electrical circuits. Since the density of heat produced by electronic equipment increases with increasing density of electronic devices in it, axial-flow blowers or oblique-flow blowers are used to cool electronic equipment.

Page 2, second, third and fourth paragraphs, replace with the following:

U. S. Patent No. 5707205, previously obtained by the applicant of the present invention, discloses that by sucking laminar air flow inside an annular wall through a slit therein when a blower is in operation, a blower inhibits leakage vortices and rotation stall from occurring at the end of a blade to improve the P-Q characteristic and reduce noise.

PCT-based Japanese Patent Laid-Open No. 6-508319 and U. S. Patent No. 5292088 disclose that a blower is arranged so that vortices of air flowing through a plurality of rings, spaced apart from each other around an axial-flow fan, increase the air flow rate.

U. S. Patent No. 5407324 discloses that a blower is arranged to make it possible for air to flow inside and outside a housing by inclining to the direction of air flow the internal perimeter of a plurality of annular plates, stacked around an axial-flow fan.

Page 3, first paragraph, replace with the following:

U. S. Patent No. 5707205 also discloses a blower whose annular wall 2 is shaped so that its sections corresponding to the middle of the upper, lower, right, and left sides of a rectangular casing body 15 are flush with the casing body 15 as shown in Figs. 13a and

13b. However, only making the contour of the annular wall rectangular as shown in Figs. 13a and 13b causes the effect of sucking laminar air flow inside the annular wall through each slit 6 to be slightly lessened, compared with an annular wall which has a round contour as shown in Fig. 12. Thus the effect of improving the P-Q characteristic and reducing noise cannot fully be provided. The casing body described by U. S. Patent No. 5707205 also has a problem of low mechanical strength and the like, because the sides of the annular wall are thinner than the other sections.

Page 5, second paragraph, replace with the following:

Although U. S. Patent No. 5407324 discloses an arrangement of the rings, the arrangement is not acceptable in terms of mass productivity, strength, and accuracy.

Page 6, third paragraph to Page 7, end of second paragraph, replace with the following:

Specifically, the annular wall with the slits is arranged by stacking a plurality of annular plates in the direction of the axis of rotation of a fan, the annular plates being separated from each other.

More specifically, the present invention provides a blower which sucks air inside an annular wall through slits as a fan

rotates, the annular wall being formed away from the ends of fan blades, the outer peripheral sections of the annular wall which correspond to the ends of fan blades being formed to be planar and substantially flush with a rectangular casing body at the middle of upper, lower, right, and left sides of the body, and slits, passing from the circular inner perimeter to the non-circular outer perimeter of the annular wall, being provided in sections of the wall which are opposite to the ends of fan blades, characterized in that the equation $n \cdot w^3/L$ = constant is met, where the width of the slits is w, the number of slits in the direction of the axis of rotation is n (n is a positive integer) and the distance in the radial direction between the inner perimeter to the outer perimeter of the annular wall is L, or alternatively the width of the slits, w, and the number of slits in the direction of the axis of rotation, n, are changed according to L so as to satisfy the close condition of said equation.

Page 9, first full paragraph, to Page 8, to end of second paragraph, replace with the following:

According to a second aspect of the present invention, which aspect relates to the annular wall associated with a fan, a plurality of annular plates are stacked through spacers in the direction of the axis of rotation, of annular plates being separated from each other, to form the annular wall with slits, and one of the plurality of annular plates which is at the most

upstream side of a main air flow produced by the fan is made thicker than the remaining annular plates. This arrangement significantly improves both the P-Q characteristic and the strength of the fan at a high level. In addition, by cutting the upstream-side end surface of the inner periphery of the annular plate on the most upstream side of the main air flow, the periphery becomes thinner, thereby improving blower performance.

According to a third aspect of the present invention, the clearance between the end of a blade and the inner perimeter of the annular wall is wider as it gets farther away from a bearing support. This arrangement has the effect of preventing the dimensions from changing with time and the end of the fan blade from touching the inner perimeter of the annular wall due to initial dimensional variations.

Page 11, third paragraph, replace with the following:

According to the final aspect of the present invention, a blower housing molding method for molding a housing of the blower is provided which employs a pair of upper and lower molds for forming the inner surface of the annular wall and a boss, and a pair of slide cores sliding opposite to each other at right angles to the moving direction of the pair of molds, wherein the slits are formed all around the annular wall by said pair of slide cores at a time, and the annular wall with the slits, a base serving as a reference for installing the blower and the boss to which a motor

cont'd B7

is secured are molded respectively as a single piece. This method can increase mass productivity and reduce noise.

Page 15, second to fourth paragraphs, replace with the following:

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Detailed Description

Referring now to the drawings, the embodiments of the present invention are described below.

Figs. 1a through 1c and Figs. 2 through 4 illustrate the first embodiment of the present invention. A blower in Figs. 1a through 1c has annular plates 7_1 through 7_4 attached to a casing body 15, which form an annular wall 2 surrounding an axial-flow fan 1. The annular plates 7_1 through 7_4 are stacked with spacers 8 in between to form a slit 6 between any two annular plates next to each other.

Page 17, sixth paragraph to Page 18, to end of second first full paragraph, replace with the following:

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In Fig. 4, w is the width of a slit, L is the length of the slit, u is air velocity, and Q is the amount of incoming air through the slit per unit time. ΔP, not shown, expresses the pressure difference across the slit, that is, the difference between the atmospheric pressure and the pressure on the fan side. As shown in Fig. 4, the velocity profile in the slit is parabolic.

The amount of incoming air through one slit per unit time, Q, is expressed as

$$Q = \Delta P \cdot w^3/(12 \cdot f\text{Å} \cdot L).$$

where fÅ is the viscosity of air. ΔP depends on the rotating speed of the fan. Since fÅ, the viscosity of air, is constant everywhere, a requirement for keeping Q constant is given by

$$w^3/L = \text{constant}.$$

B9 The above equation shows that a well performing blower can be provided which inhibits blade vibration, disk circulation, and the like, thus eliminating a deterioration in the P-Q characteristic and an increase in noise, since reducing the value of w according to the above equation makes the amount of incoming air constant all around the fan on the four sides, where L is small.

Figs. 5a through 5b show the second embodiment. In the first embodiment, the width of a slit, w, is continuously changed to keep flow resistance constant in the intervals 7s and 7r, with the same number of slits in the intervals 7s and 7r. In the second embodiment, on the other hand, the width of a slit, w, and the number of slits, n, are changed at the same time to keep flow resistance constant in the intervals.

Page 21, fourth paragraph to Page 22, beginning of first full paragraph, replace with the following:

B10 Similarly, the width of a slit 6 in the interval 7r is set smaller at its ends (portions adjacent to intervals 7s) than in the

middle of the interval 7r to reduce variations in the amount of incoming air at boundary points between intervals 7s and 7r where the number of slits changes.

Fig. 6 shows the third embodiment. The blower has slits 6 in an annular wall 2 surrounding an axial-flow fan 1. Specifically, annular plates 7_1 through 7_5 whose four corners are cut to fit in a rectangular casing body 15 are stacked with spacers 8 in between, and a slit 6 is formed between any two annular plates next to each other.

Page 23, fourth paragraph to Page 24, to end of first full paragraph, replace with the following:

In the above embodiments, the width of a slit is continuously changed. On the other hand, when the width is intermittently changed as shown in Figs. 10a and 10b, better performance can be ensured, compared with Figs. 13a and 13b, in which the width of a slit is constant, though the performance is a littler lower, compared with Figs. 1a through 1c, in which the width of a slit is continuously changed. Intermittently changing the width of a slit as in Figs. 10a and 10b allows the contour of a slit to be simpler than continuously changing the width, so that the slit can easily be formed, thus leading to a low blower cost. Thus a high cost-per-performance blower can be provided.

Figs. 14a through 14c show a blower of the fourth embodiment. As shown in Fig. 14c, the width of the annular plates 7_1 through 7_5,

W, may be set equal or substantially equal to that of an axial-flow fan 1 in the direction of its axis. The width of each slit, w, is changed so that flow resistance is almost equal at every location.

Page 24, third full paragraph to Page 25, paragraph continued, replace with the following:

As shown in Fig. 15a, a conventional blade has a shape formed by radially jointing together blades whose cross-sections obtained by cutting them through the surfaces of cylinders concentric with the rotational axis are airfoils. This is because a conventional fan is designed, with radial air flow neglected. However, calculated values and actual values do not disagree widely as long as a fan has an annular wall through which air does not come in from outside and the flow resistance of air is relatively low. To improve fan characteristic when the flow resistance of air is a little larger than in the case above, advance blades are generally used, the middle of which in the direction of their chords is inclined toward the direction of rotation.

Page 26, fourth paragraph, replace with the following:

Blade thickness of a conventional fan changes along lines l-l′, m-m′, and n-n′ in Fig. 17a are as shown in Figs. 17b, 17c, and 17d, respectively.

Page 29, second paragraph to Page 30, to beginning of first full paragraph, replace with the following:

In the embodiment, the slits 6 in the annular wall 2 are formed in a plane perpendicular to the axis of rotation of the fan. When the slits are inclined up on the leading edge side u1 (up the air flow 5) and down on the trailing edge side (down the air flow 5) as shown in Fig. 20, changing the inclination angle of the blade end continuously so that the angle is equal to the slit angle prompts air to smoothly flow in and improves the P-Q characteristic. In Fig. 20, the blades 16 are blade cross sections obtained by cutting blades at several locations along planes containing the axis of rotation 4.

Figs. 21a through 21c show another embodiment of the housing 17. An axial-flow fan 1 is the case with the fourth embodiment. A housing 17 in the fifth embodiment is nearly the same as in the case of the fourth embodiment. The thickness t5 of the annular plate 7_5 on the top stage is larger than those of the other annular plates 7_1 through 7_4. The annular plate 7_5 differs from the others only in that the upper edge y of the inner surface of the annular plate 7_5 (the edge is up an air flow 5) is cut to be arcuate as shown in Fig. 21c and that the inner surface of the annular plate 7_5 is tapered so that the inner circumference progressively becomes longer toward its upper end. z represents the step formed between the upper and lower ends by tapering the inner surface.

Page 32, line 1 to end of first full paragraph, replace with the following:

Figs. 23a and 23b show another embodiment of the housing 9. An axial-flow fan 1 is the case with the fourth embodiment. The housing in the sixth embodiment is almost the same as in the fifth embodiment but only differs from the housing in the fifth embodiment in that the housing in the sixth embodiment has expanded sections 30 where the width of slits 6, w, is further increased near spacers 20 supporting annular plates 7_1 through 7_5.

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Page 33, fifth full paragraph to Page 34, to end of first full paragraph, replace with the following:

As described above, according to the present invention, the strength of the annular plates decrease because they are partially thin. As shown in Figs. 23a, 23b and 24b however, the expanded section 30 whose inner surface is formed to be arcuate allows stress concentration to be modified and strength (especially breaking strength) to increase when the joint between a spacer and an annular plate is loaded.

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The seventh embodiment cancels the effect of spacers 13, using an arrangement differing from that used for the sixth embodiment. An axial-flow fan 1 is the case with the fourth embodiment. Figs.

25a and 25b show a housing 17 in the seventh embodiment. The seventh embodiment only differs from the fifth embodiment in that the housing 17 is provided with notches 33 so that the radial length of annular plates 7_1 through 7_5 is short near spacers 20.

Page 34, fourth paragraph to Page 35, end of first full paragraph, replace with the following:

The housing in Figs. 25a and 25b is provided only around the outer circumference of the annular plates 7_1 through 7_5 with the notches 33. Even when notches 34, including the outer surfaces of the spacers 20, are formed as in the housing 17 in Figs. 26a and 26b, the housing has a little lower strength but exercises one and the same effect.

The fourth through seventh embodiments aim to improve the characteristics of a blower. On the other hand, although the eighth embodiment is a litter lower in performance than the other embodiments, it is intended to provide a high cost-per-performance blower by enhancing suitability for mass production and reducing part costs while minimizing a deterioration in performance.

Page 37, line 1 to end of first full paragraph, replace with the following:

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Figs. 30a through 30c show a housing 17 for a blower of the ninth embodiment. An axial-flow fan 1 in the embodiment is the case with the fourth embodiment. The housing 17 in the ninth embodiment slightly differs only in spacer shape from that in the eighth embodiment. In Figs. 30a through 30c, the spacers 23a and 23b in the eighth embodiment are spacers 27a and 27b.

<u>IN THE CLAIMS</u>:

Please cancel claims 1-7 and 14-16 without prejudice or disclaimer.

Please amend claims 13, 23 and 24 as follows:

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13. (Amended) A blower according to claim 9, wherein the blade inclination angle near the end of the blade is set equal to the angle of the slits provided in the annular wall.